Recording device with loading means status indication and method for recording using the
loading means status

The invention relates to a recording device comprising a loading means to load
a recording medium and comprising loading means status determining means for determining
a loading means status, and a method for recording information on a recording medium
comprising the steps of inserting the recording medium in a loading means, operating the
5   loading means and starting a recording operation.

Such a recording device and method is known from the working draft NCITS
T10/1363-D revision 10g SCSI Multimedia Commands – 3 (MMC-3) that describes
commands for recording devices with removable recording media for instance tapes or
optical disc.

10   Before the recording can commence the loading operation and the
initialization or calibration of the recording device and the recording medium must be
completed.

The completion of the loading operation is indicated by a loading means status
that can report tray open and tray closed.

15   The disadvantage of such a recording device is that it introduces a delay
between the start of the loading operation and the start of the recording operation that users of
these devices dislike.

It is an objective of the invention to reduce the delay between the start of the
loading operation and the start of the recording operation.

20   This objective is achieved in that the recording device of the invention is
characterized in that the loading means status determining means are operative to detect a
loading means status representing a loading means operation of loading the recording
medium.

The detection of the status of the actual loading operation allows the recording
25   device to start preparing for the start of the recording. Thus the recording device does not
need to wait for confirmation of the completion of the loading process before preparing for
the start of the recording. Thus a reduction of the delay between the start of the loading
operation and the start of the recording operation is achieved.

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A further embodiment is characterized in that the loading means status comprises a progress indicator.

When the recording device knows how far along the loading operation has progressed it can start the preparations for the start of the recording at the appropriate time
5   ensuring that all preparations are completed when the actual recording can start.

When multiple preparations are required the recording device can start the preparations at the appropriate time to ensure not all preparations start at the same time, thus saving resources in the recording device. Alternatively each preparation can be started at the last possible moment ensuring they are all completed when the loading operation is
10   completed, reducing the delay between the start of the loading operation and the start of the recording operation.

A further embodiment is characterized in that the progress indicator indicates a time duration until the loading means loading operation is complete.

Besides a percentage indicator a time indication may be very useful. The
15   recording device may for instance learn from previous loading operations how long it will take to complete the loading operation and can more accurately predict the remaining duration of the loading operation. Since the loading operation is performed by a mechanical device the actual duration loading operations may vary widely from recording device to recording device. Since the recording device then knows the actual duration of the loading
20   operation of its own loading means there is no need for engineering fixed safety margins into the recording device to ensure all recording devices from a production series have completed the preparations before the actual recording starts. Thus a per device reduction of the delay between the start of the loading operation and the start of the recording operation is achieved.

A further embodiment is characterized in that the recording device is operative
25   to start a recording operation when a loading means status representing the loading means operation of loading the recording medium is detected.

As soon as the actual loading operation is detected the time until the recording medium is loaded and available for recording can be predicted, thus allowing the appropriate scheduling of preparations for the start of recording.
30   A further embodiment is characterized in that the recording device is operative to start a recording operation when the progress indicator associated with the loading means status representing the loading means operation of loading the recording medium reaches a predetermined value.

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The recording device knows how much time it needs to prepare for the start of the recording. The recorder can thus start its actions at the moment when the progress indicator reaches a certain value.

A further embodiment is characterized in that the recording device further

5   comprises a buffer with a buffer size and that the predetermined value of the progress indicator is determined by the buffer size.

One of the preparations the recorder can take before the actual recording on the recording medium starts is to store the information to be recorded in a buffer. The buffer has a buffer size that can store a certain amount of information. This certain amount of

10   information corresponds to a duration for information that is a stream of information with a certain, possibly variable, bit rate.

It is thus possible for the recording device to start buffering the information for x seconds during the loading operation before the start of the recording operation on the recording medium because the recording device knows that it will certainly take less than x

15   seconds before the loading operation is completed. The progress indication allow the recording device to determine how much more time is needed before the recording on the recording medium can commence and whether the buffer is large enough to buffer the information until the recording on the recording medium can commence.

Again, because there is a progress indicator the recording device can

20   determine the remaining duration of the loading operation during the loading operation and does not need to determine the start of the loading operation and estimate the start of the recording operation based on typical loading operation durations. A reduction of the delay between the start of the loading operation and the start of the recording operation is thus achieved.

25   A further embodiment is characterized in that the recording device is a recording device for recording real time information.

The delay is especially harmful when recording real time information.

For instance when considering a Video Cassette Recorder it must be noted that when the user sees interesting real time information, for instance a TV program, and wants to

30   record this program, he must insert a video tape (after having looked around for an empty one), wait until the loading operation is completed, the tape is extracted from the cassette and looped through the VCR drive and then press start. Potentially valuable real time information is lost and cannot be retrieved.

4

It is clear that a real time stream, such a s a video stream, cannot be halted. Thus, in order to lose the least amount of data when a new recording medium is to be loaded into the recording device while the real time information is arriving the buffering should start as early as possible. The invention allows the earliest start of the recording and also the

5   earliest start of buffering as explained above thus enabling the minimization of information lost when starting to record real time information. Given a buffer that can buffer the information during the loading operation no information is lost after the recording medium is placed in the loading means and the recording is initiated by pressing the record button or issuing the record command.

10   In addition, because of the availability of the progress indicator, the use of the buffer can be optimized to match the buffering capacity to the time required for the loading operation. The same amount of buffer can be used with loading means with varying loading durations. For instance a bit rate reduction can be performed on the incoming information when a recording device has a slower than average loader. The buffer is thus still sufficient to

15   avoid the loss of information. When a recording device has a faster than average loader the spare buffer capacity can be used to buffer the information using a higher bit rate achieving higher quality.

A further embodiment is characterized in that the recording device is operative to abort a recording operation when the loading means status representing the blocked

20   loading means is detected.

Once the loading operation commenced it is important to detect a blocked loading means.

This allows the buffering means to be adjusted, for instance by storing the information using a lower bit rate, to allow the user to correct the situation.

25   A further embodiment is characterized in that the recording device is operative to issue a warning on a display device.

Before the user can take a corrective action a warning must be issued either audible or on a display or by reporting a status 'blocked loading means' to a higher level application through a software or hardware interface.

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The invention will now be discussed based on figures.

Figure 1 shows a recording device.

Figure 2 shows the mechanical drive mechanism.

Figure 1 shows a recording device.

5   The recording device 1 comprises an interface 2 for communicating with other devices via an input/output 13. The recording device further comprises a processor 3 which comprises a status register 4 for reporting the loading means status and a buffer for temporarily storing incoming information before storing the information on the recording medium. The processor 3 communicates via a display interface 11 with a display and

10   keyboard unit 6. This allows the recording device 1 to receive commands from a user, for instance the command 'start recording' and can display information regarding the recording process, for instance loading means status or warnings. It is evident that the receipt of commands and the reporting of the status can also be performed over the interface 2 to other devices connected to the recording device 1, for example a computer in case the recording

15   device is a PC based recording device communicating with the computer over an IDE or SCSI interface. The processor 3 further controls a mechanical drive mechanism 7.

The Mechanical drive means comprises a loading means which is controlled via a first interface 8, recording means such as an optical pickup unit which is controlled via a bidirectional interface 9 for writing information on a recording medium, drive means for

20   driving the recording medium which is controlled via the first interface 8 and loading means status determining means which are read out via a read-out interface 10.

When a command to start a loading means related operation, in this example recording, is received by the recording device 1, either via the interface 2 or the display and keyboard unit 6 the processor the processor 3 starts the operation of the loading means, for

25   instance the loading of the recording medium.Via the read-out interface 10 the actual status of the loading means is read and the processor starts the preparations for recording. One of the preparations is to start filling the buffer 5 with information from the interface 2 ones the processor 3 is sure that the remianing time for the loading means to complete the loading operation is less than the amount of information received in that time that can be buffered in

30   the buffer 5.

Figure 2 shows the mechanical drive mechanism.

The mechanical drive mechanism 7 comprises a first motor 22 to operate the loading means. The first motor is connected via an axle to a gear 23 which drives a corresponding gear 24 mounted on the loading means 25. The first motor22 can thus be

controlled via an interface 8A in order to load or unload the recording medium. The loading
means 25 comprise a position indicator 21 which allows a position determining means 20 the
determination of the position of the loading means. The position indicator 21 and the position
determining means 20 together form a position encoder where the position determining
5   means 20 reports the status of the loading means via an interface 10.

The mechanical drive mechanism 7 further comprises an optical pickup 26 for
writing to and reading from the recording medium via an interface 9 and a drive motor 27 to
drive the recording medium, for instance a spindle motor driving the optical recording disc in
a CD or DVD player. The position encoder can be implemented in various ways including
10   optical sensors sensing the movement of a reflective strip with markings mounted on the
loading means. Alternatively the first motor 22 can comprise an encoder that supplies
information about the angular position of the motor axis thus allowing the determination of
the loading means. In addition the optical pickup unit 26 can detect movement of the loading
means when a strip with markings is positioned on the loading means such that movement of
15   the loading means results in a corresponding movement of the strip in front of the optical
pickup unit 26. If an absolute position indication is not required the strip with markings
results in a detectable signal for the position determining means from which the position
determining means can derive movement of the loading means and the direction of the
loading means.
20

Implementation in the command structure of an recording device.

In the present command structure there are two locations where loading means
status, i.e. tray status, information is provided. The first location is in the media status byte
25   definition.

Table 1 – Media Status Byte Definition

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved						Media Present	Door or Tray open

The Media Present status bit indicates if there is media present in the Logical Unit. A bit of 1
indicates that there is media present in the Logical Unit. This bit is reported independently
30   from the Door or Tray Open bit. If the Logical Unit does not support the capability of

reporting the media state while the door or tray is open, it shall set this bit to zero when the door or tray is open.

Door or Tray Open bit indicates if the Tray or Door mechanism is in the open state. A bit of 1 indicates the door/tray is open.

5   The data returned, with a class code 110b, is defined in of the NCITS 10/1363-D working draft.

The second location where the loading means status is reported is in the mechanism status header as shown in table 3, accessible via the mechanism state command of table 1. Here the mechanism state field reports the state of the mechanism.

10   The Current Slot field (an 8-bit field) in the mechanism status header indicates the Current Slot selected for changers.

The lower 5 bits of Current Slot can be used as a progress indicator because for a loading means for a single recording medium the changer state fields are not needed. The MECHANISM STATUS Command (Table 2) requests that the recording device respond

15   with the current status of the device. This command is intended to provide information to the Initiator about the current operational state of the Logical Unit. The recording device takes operational direction from both a host and the user. Movement of media in/out of the recording device as well as Play operation may be due to external controls or host commands. This command provides a method that allows the host to know what has transpired with the

20   changer mechanism. The recording device is not a changer model.

Table 2 - MECHANISM STATUS Command Descriptor Block

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code=BDh							
1 - 7	Reserved							
8	(MSB)			Allocation Length				
9								(LSB)
10	Reserved							
11	Reserved (Control Byte)							

The ALLOCATION LENGTH field specifies the maximum length, in bytes, of the Mechanical Status Parameter list, see Table 3, that shall be transferred from the recording device to a

25   host. The ALLOCATION LENGTH field of zero indicates that no data shall be transferred. This condition shall not be considered an error.

The CONTROL BYTE field shall be reserved. The recording device ignores this field.

8

The Mechanism Status Parameter list returned contains a header (**Error! Reference source not found.**) only. The recording device does not support the changer commands, then the number of slot tables returned to a host shall be zero.

Table 3 - Mechanism Status Parameter List

Bit Byte	7	6	5	4	3	2	1	0
0 - 7	Mechanism Status Header							

Table 4 - Mechanism Status Header

Bit Byte	7	6	5	4	3	2	1	0
0	Fault (0)	Changer State=0		Current Slot (Low order 5 bits)=0				
1	Mechanism State (111b)			DoorOpen	Reserved=0	Current Slot (High order 3 bits)=0		
2	(MSB)							
3				Current LBA				
4								(LSB)
5	Number of Slots Available=00h							
6	(MSB)							
7				Length of Slot Table(s)=0				(LSB)

The **FAULT** bit shall default to zero (0b), when a tray is blocked this bit shall be set to 1.

The **CHANGER STATE** field shall be cleared to zero.

The **CURRENT SLOT** shall be cleared to zero.

The **MECHANISM STATE** field (**Error! Reference source not found.**: codes in bold letter with light green background color) encodes the current operation of mechanism by the recoridn device. The default value of this field shall be set to 111b.

The loading means status can be reported in the mechanism state field as shown in table 4.

Table 5 - Mechanism State Field and DoorOpen Status

Mechanism State	Definition	DoorOpen State	Implementation
000b	Idle	0	✓
001b	Playing (Audio or Data)	0	✓
010b	Tray stopped completely outside	1	✓
011b	Active with Initiator, Composite or Other Ports in use (i.e. READ)	0	NA
100b	Tray moving inside	1	✓
101b	Tray moving outside	1	✓
110b	Tray stopped and blocked	1	✓
111b	No State Information Available. Default	X	✓
All others: Not supported by the Apache3.			

The **DOOROPEN** bit=0, when a tray is closed. Otherwise this bit shall be set to one.

If not playing audio, the **CURRENT LBA** field shall be cleared to zero. Otherwise the value shall be calculated from current sub-channel.

The **NUMBER OF SLOTS AVAILABLE** shall be cleared to zero.

The **LENGTH OF SLOT TABLE** shall be cleared to zero.

When a medium is loaded by the recording device with the tray closed, a TOC shall be read automatically. This issues NewMediaEvent also.

Alternatively the changer state field can be used since it already comprises similar information and because this field is not used for loading means for single recording media.

Supported error reporting is defined in Table 6.

Table 6 - Supported errors for MECHANISM STA TUS Command

Error			Reference
Deferred Errors			Error! Reference source not found.
General Errors			Error! Reference source not found.
Sense Key	ASC	ASCQ	Description
5	15	01	ILLEGAL REQUEST, MECHANICAL POSITIONING ERROR
5	1A	00	ILLEGAL REQUEST, PARAMETER LIST LENGTH ERROR
5	20	00	ILLEGAL REQUEST, INVALID COMMAND OPERATION CODE
5	26	00	ILLEGAL REQUEST, INVALID FIELD IN PARAMETER LIST
6	28	00	UNIT ATTENTION, NOT READY TO READY C HANGE, MEDIUM MAY HAVE CHANGED
6	29	00	UNIT ATTENTION, POWER ON, RESET, OR BUS DEVICE RESET OCCURRED
Notes: All values are in hexadecimal. When no value for SK is given, the error is applicable to multiple sense keys.			

CLAIMS:

1.   A recording device comprising a loading means arranged to load a single
recording medium and comprising loading means status determining means for determining a
loading means status,
characterized in that the loading means status determining means are operative to detect a
5   loading means status representing a loading means operation of loading the recording
medium

2.   A recording device comprising a loading means arranged to load a single
recording medium and comprising loading means status determining means for determining a
10   loading means status,
characterized in that the loading means status determining means are operative to detect a
loading means status representing a loading means operation of unloading the recording
medium

15   3.   A recording device comprising a loading means arranged to load a single
recording medium and comprising loading means status determining means for determining a
loading means status,
characterized in that the loading means status determining means are operative to detect
loading means status representing a blocked loading means.

20

4.   A recording device as claimed in claim 1 or 2,
characterized in that the loading means status comprises a progress indicator.

5.   A recording device as claimed in claim 4 when depending on claim 1,
25   characterized in that the progress indicator indicates a time duration until the loading means
loading operation is complete

6.   A recording device as claimed in claim 1, 4 or 5,
characterized in that the recording device is operative to start a recording operation when a

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loading means status representing the loading means operation of loading the recording
medium is detected

7.   A recording device as claimed in claim 6,

5   characterized in that the recording device is operative to start a recording operation when the
progress indicator associated with the loading means status representing the loading means
operation of loading the recording medium reaches a predetermined value

8.   A recording device as claimed in claim 7,

10   characterized in that the recording device further comprises a buffer with a buffer size and
that the predetermined value of the progress indicator is determined by the buffer size.

9.   A recording device as claimed in claim 1 to 8,

characterized in that the recording device is a recording device for recording real time

15   information.

10.   A recording device as claimed in claim 4,

characterized in that the recording device is operative to abort a recording operation when the
loading means status representing the blocked loading means is detected.

20

11.   A recording device as claimed in claim 10,

characterized in that the recording device is operative to issue a warning on a display device.

12.   A recording device as claimed in claim 1, 2 or 3

25   characterized in that the loading means status determining means comprises loading means
status reporting means accessible via an external interface of the recording device.

13.   A recording device as claimed in claim 12

characterized in that the loading means status reposting means is operative to report a loading

30   means status in a mechanism status header.

14.   A recording device as claimed in claim 13

characterized in that the loading means status reposting means is operative to report a loading
means status in a changer state field in the mechanism status header.

15.   A recording device as claimed in claim 14
characterized in that the loading means status reposting means is operative to report a loading
means status of 100b when the loading means is loading the recording medium, a loading
5   means status of 101b when the loading means is unloading the recording medium, a loading
means status of 110b when the loading means is blocked.

16.   A method for recording information on a recording medium comprising the
steps of inserting the recording medium in a loading means, operating the loading means and
10   starting a recording operation,
characterized in that starting the recording operation coincides with operating the loading
means.

17.   A method for recording information on a recording medium as claimed in
15   claim 16,
characterized in that a status of the loading means is determined before starting the recording.

18.   A method for recording information on a recording medium as claimed in
claim 17,
20   characterized in that the status comprises a progress indicator with a value, and that a
predetermined value of the progress indicator must be reached before starting the recording.

19.   A method for recording information an a recording medium as claimed in
claim 18,
25   characterized in that the progress indicator indicates a time duration until the operating of the
loading means is complete

20.   A method for recording information an a recording medium as claimed in
claim 19,
30   characterized in that before being recorded the information is stored in a buffer with a buffer
size and that the predetermined value of the progress indication is determined by the buffer
size.

21.   A method for recording information an a recording medium as claimed in
claim 16,

characterized in that the recording operation is aborted when the loading means status
representing a blocked loading means is detected.

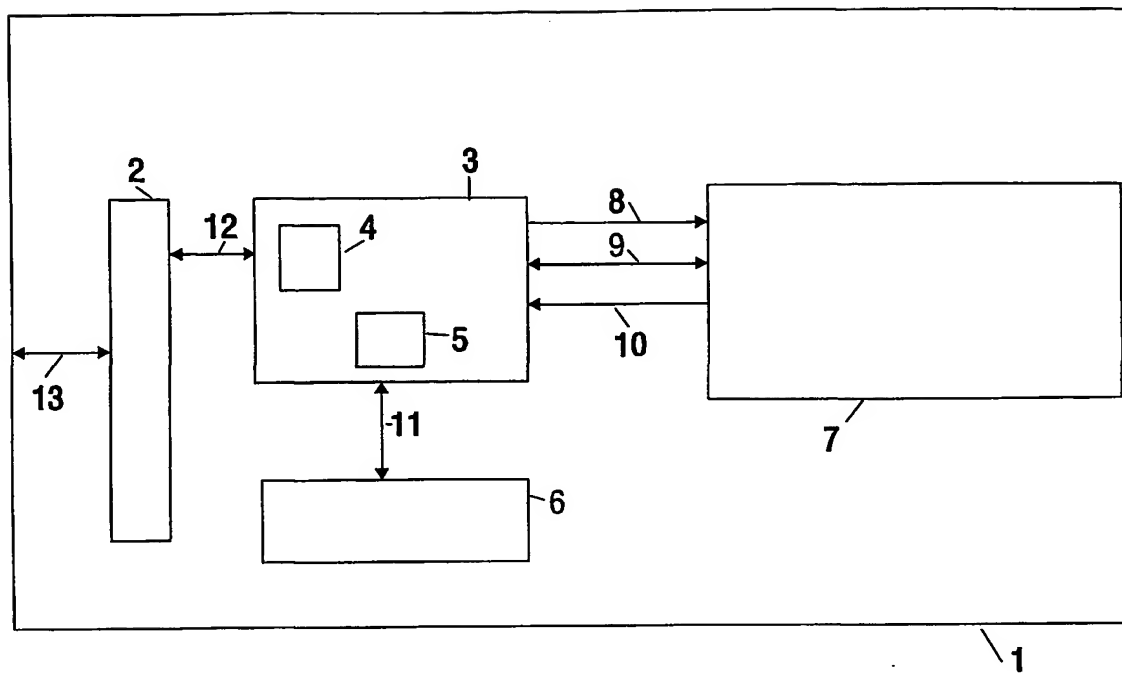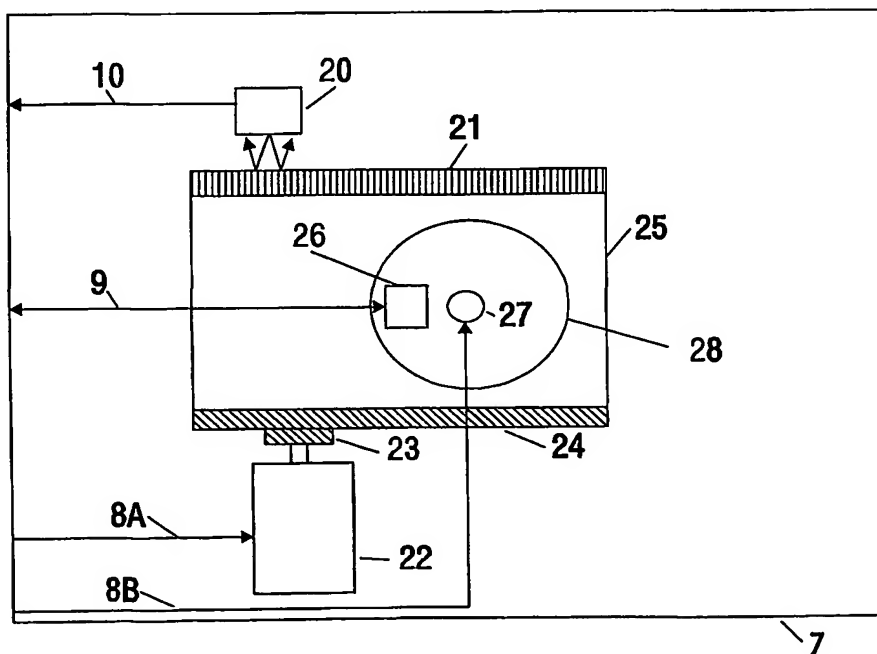FIG.1

FIG.2

INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7   G11B19/10   G11B17/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7   G11B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 2000, no. 14, 5 March 2001 (2001-03-05) & JP 2000 322816 A (SONY CORP), 24 November 2000 (2000-11-24) abstract	1,3,6,9, 16,17
X	PATENT ABSTRACTS OF JAPAN vol. 1995, no. 02, 31 March 1995 (1995-03-31) & JP 6 309773 A (SONY CORP), 4 November 1994 (1994-11-04) abstract	1-3,6,9, 16,17

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 August 2004	31/08/2004

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INTERNATIONAL SEARCH REPORT

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Patent document cited in search report		Publication date	Patent family member(s)	Publication date
JP 2000322816	A	24-11-2000	NONE	
JP 6309773	A	04-11-1994	NONE	